HOUSATONIC RIVER FLOOD CONTROL

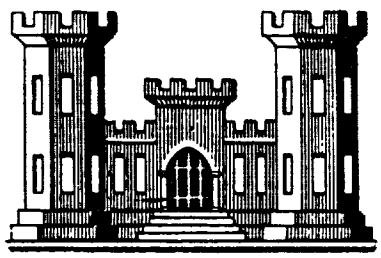
HANCOCK BROOK

DAM & RESERVOIR

HANCOCK BROOK, CONNECTICUT

DESIGN MEMORANDUM NO. 3

GENERAL DESIGN



U.S. Army Engineer Division, New England
Corps of Engineers Waltham, Mass.

MARCH 1962

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

WALTHAM, MASSACHUSETTS

FLOOD CONTROL PROJECT

HANCOCK BROOK DAM AND RESERVOIR

HANCOCK BROOK

HOUSATONIC RIVER BASIN

CONNECTICUT

DESIGN MEMORANDUM NO. 3

GENERAL DESIGN

MARCH 1962

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDGW

27 March 1962

SUBJECT: Hancock Brook Dam and Reservoir, Hancock Brook, Housatonic River Basin, Connecticut, Design Memorandum No. 3 - General Design

TO: Chief of Engineers
ATTENTION: ENGCW-E
Department of the Army
Washington, D. C.

In accordance with EM 1110-2-1150, there are submitted herewith for review and approval, ten (10) copies of Design Memorandum No. 3 - General Design for the Hancock Brook Dam and Reservoir, Hancock Brook, Housatonic River Basin, Connecticut.

FOR THE DIVISION ENGINEER:

for JOHN WM. LESLIE
Chief, Engineering Division

Incl
Des. Memo No. 3
(10 cys)

FLOOD CONTROL PROJECT

HANCOCK BROOK DAM

HANCOCK BROOK

HOUSATONIC RIVER BASIN

CONNECTICUT

DESIGN MEMORANDA INDEX

Number	Title	Submission Date	Approved
1	Hydrology and Hydraulic Analysis	27 Dec 1961	29 Jan 1962
2	Site Geology	21 Feb 1962	22 Mar 1962
3	General Design	27 Mar 1962	
4	Relocations		
5	Concrete Materials	20 Nov 1961	7 Dec 1961
6	Embankments and Foundations		
7	Real Estate		
8	Detailed Design of Structures		
9	Reservoir Management		

HANCOCK BROOK DAM AND RESERVOIR

HANCOCK BROOK

HOUSATONIC RIVER BASIN, CONNECTICUT

DESIGN MEMORANDUM NO. 3

GENERAL DESIGN

LIST OF TABLES

LIST OF PLATES

HANCOCK BROOK RESERVOIR
HANCOCK BROOK
HOUSATONIC RIVER BASIN
CONNECTICUT

A. PERTINENT DATA

1. Purpose — Flood Control

2. Location of Dam

State	Connecticut
County	Litchfield
Town	Plymouth
River	Hancock Brook, 3.25 miles upstream from its confluence with the Naugatuck River, in the Town of Waterbury, Conn.
Distance from:	Waterbury, Conn., 4.5 miles
Distance from:	Hartford, Conn., 21.7 airmiles

3. Drainage Areas

	Square Miles
Hancock Brook at Damsite	12.0
Hancock Brook at Mouth, confluence with Naugatuck R	16
Naugatuck River at Mouth, confluence with Housatonic R	312

4. Stream Flow

Record of U.S.G.S. Gaging Station on Leadmine Brook at Thomaston, October 1931 to September 1958.

(D. A. = 24.0 Sq. Mi.)

Time	c.f.s.	c.f.s. / sq. mi.
Average annual (27 years)	48.6	2.03
Maximum year (1956)	73.0	3.04
Minimum year (1932)	24.2	1.01
Maximum month (March 1936)	268	11.17
Minimum month (August 1949)	0.7	0.03
Maximum day (August 19, 1955)	3660	152.50
Minimum day (June 26, 1949)	0.1	0.004

5. Maximum Floods of Record

Record of U.S.G.S. Gaging Station on Leadmine Brook at Thomaston, October 1931 to September 1958.

(D. A. = 24.0 Sq. Mi.)

Date	Peak Discharge c.f.s.	c.f.s./sq.mi.
August 1955	10,400	433.3
December 1948	5,150	214.6
October 1955	3,100	129.2
September 1938	3,050	127.1

6. Criteria for Spillway Design Flood

Total volume of rainfall, inches	24.0
Infiltration rate, inches per hour	0.05
Total volume of runoff, inches	22.8
Total volume of runoff, acre feet	14,590.
Peak inflow, c.f.s.	20,700
Duration of storm, hours	48
Reservoir stage at start of flood, ft., m.s.l.	484.0 (Spwy. Crest)
Conduit	Inoperative

7. Reservoir Elevations, Areas and Capacities

Town affected - Plymouth

	Elevation (ft.m.s.l.)	Water Area (Acres)	Capacity Acre Feet	Inches-Runoff
Conduit Invert	454	4	10	.016
Management Pool	460	40	130	0.20
Spillway Crest	484	266	4,030	6.33
Guide Taking Line	490	298	5,700	8.95
Maximum Surcharge	499.7	346	8,900	13.97

8. Dam and Appurtenant Structures

Type	Rolled-earth fill
Length, feet	630
Maximum height above stream bed, ft.	57
Slopes (Preliminary)	1 on 2.5

9. Elevations, ft. m.s.l.

Top of Dam	505.0
Streambed at downstream toe	547
Streambed at centerline	548
Top width, feet	20
Freeboard above spillway design flood height, ft.	5.3

10. Spillway

Type	Uncontrolled chute in rock with concrete sill
Elevation of crest, ft. m.s.l.	484.0
Length of crest	100.0
Maximum head, ft.	15.7
Maximum inflow from spillway design flood, c.f.s.	20,700
Spillway peak discharge, c.f.s.	16,600

11. Outlet Works

a. Outlet Conduit

Type	Rectangular concrete, ungated
Size	3' - 0" x 4' - 6"
Length, portal-portal, ft.	247
Sill elevation, ft. m.s.l.	454

b. Outlet Capacity

Reservoir at spillway crest, c.f.s.	377
Reservoir at maximum surcharge, c.f.s.	465

12. Railroad Dike

Type	Rolled-earth fill
Top elevation, ft. m.s.l.	505
Top width, feet	15
Maximum height above toe, feet.	35
Maximum base width, feet.	115
Total length, feet.	2,300
Slopes (Preliminary)	1 on 2

13. Real Estate

a. Fee Area

(1) Improvements
26 Residential Units

(2) Land

Classification	Acres
26 Improved Homesites	13
Developable Land	96
Wooded Land	586
Sand and Gravel Land	60
Low Wet Land	81
Roads, Brooks & Water Area	36
	872

b. Easement Area

Borrow Area Access Road	1 Acre

14. Relocations

	Existing Mileage	Proposed Mileage
a. Town Roads		
Relocate	0.78	0.78
Raise	0.14	0.14
Abandon	0.57	-
Improve	0.48	0.48
b. Railroad	2.1	2.0
c. Utilities		
Relocate	1.78	1.96
Raise	0.09	0.09
Abandon	3.30	-

15. Principal Quantities, C. Y.

	Dam	Highway Relocation	Railroad Relocation	Total
Common Excavation	61,500	34,000	238,000	333,500
Borrow Excavation	72,700	-	7,000	79,700
Rock Excavation	19,000	7,500	58,000	84,500
Rolled Fill	104,300	38,100	121,000	263,400
Rock Slope Protection	16,000	1,500	12,000	29,500
Concrete	555	1,800	300	2,655

16. Estimated Project Costs

Lands and Damages	$ 753,000
Relocations (R.R., Highway and Utilities)	1,353,000
Reservoir	3,000
Dam and Appurtenant Structures	425,000
Permanent Operating Equipment	4,000
Preauthorization Studies	20,000
Engineering and Design	270,000
Supervision and Administration	162,000
Total Estimated Project Cost	$2,990,000

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
OFFICE OF THE DIVISION ENGINEER
WALTHAM 54, MASS.

FLOOD CONTROL PROJECT

HANCOCK BROOK DAM AND RESERVOIR

HANCOCK BROOK
HOUSATONIC RIVER BASIN
CONNECTICUT

DESIGN MEMORANDUM NO. 3
GENERAL DESIGN

MARCH 1962

B. INTRODUCTION

1. Purpose. The purpose of this memorandum is to set forth the general plan for the Hancock Brook Dam and Reservoir Project, and to facilitate the preparation and review of detailed design memoranda, plans and specifications.

2. Scope. This memorandum covers the entire project. It presents general data on the components, functions, costs and benefits of the project for Hancock Brook Dam and Reservoir. The data contained herein will be revised and expanded, as required, by supplement to this memorandum and by subsequent design memoranda.

C. AUTHORIZATION

3. Authorization. a. Flood Control Act. The flood protection plan for the Housatonic River Basin was approved by the Flood Control Act dated 14 July 1960 (Public Law 86-645, 86th Congress), which reads in part as follows:

"The project for flood control dams and reservoirs on the Naugatuck River, Connecticut, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 372, Eighty-sixth Congress, at an estimated cost of $10,230,000."

Full monetary authorization for the project was provided in this Act.

b. House Document. In House Document No. 372, 86th Congress, 2d Session, the Chief of Engineers recommends the construction of four reservoirs for the control of floods on the Naugatuck River, including the Hancock Brook Reservoir, generally in accordance with the plans of the Division Engineer and with such modification thereof as in the discretion of the Chief of Engineers may be advisable; provided that responsible local interests give assurances satisfactory to the Secretary of the Army that they will establish encroachment lines downstream of the recommended dams to permit reasonable, efficient reservoir operation; and provided further, that any one of the recommended reservoirs may be built independently of the others.

The Chief of Engineers further recommends that small pools, utilizing from two to four per cent of the total storage available at spillway crest, be incorporated in the plan of improvement at each of the recommended reservoirs for the mitigation of recreational and fish and wildlife losses.

D. INVESTIGATIONS

4. Previous Investigations. a. "308 Report." A report dated June 25, 1931, and printed as House Document No. 246, 72d Congress, 1st Session covered navigation, water power, flood control and irrigation in the Housatonic River Basin. The report found that further improvements were not warranted at that time.

b. 1940 Report. A report dated June 20, 1940, and printed as House Document No. 338, 77th Congress, 1st Session, recommended construction of the Thomaston Reservoir on the Naugatuck River above Thomaston, Connecticut. This project was authorized by Public Law 534, 78th Congress, 2d Session, approved December 22, 1944.

c. 1956 Report. An interim report dated 31 May 1956, and printed as House Document No. 81, 85th Congress, 1st Session, covered flood control on the Upper Naugatuck River above Torrington, Connecticut, and recommended the construction of the Hall Meadow Brook Reservoir and the East Branch Reservoir. These projects were authorized by Public Law 500, 85th Congress, approved July 3, 1958.

d. 1958 Report. An interim report dated 30 June 1958, and printed as House Document No. 372, 86th Congress, 2d Session, recommends that the authorized plan for flood control in the

Housatonic River Basin be modified to provide for construction of flood control dams and reservoirs on Northfield Brook, Branch Brook, Hancock Brook and Hop Brook.

5. Reports of Other Agencies. a. NENYIAC Report. Flood control and allied water uses are also considered in Part 2, Chapter XXII, "Housatonic River Basin," of The Resources of the New England-New York Region. This comprehensive report inventoried the resources of the New England-New York area and recommended a master plan to be used as a guide for the regional planning, development, conservation, and use of land, water, and related resources of the region. Also included were proposals to reduce flood losses. Prepared by the New England-New York Interagency Committee, the report was submitted to the President of the United States by the Secretary of the Army on April 27, 1956. Part 1 and Chapter I of Part 2 are printed as Senate Document 14, 85th Congress, 1st Session.

b. Naugatuck Valley River Control Commission. The Naugatuck Valley River Control Commission has issued an Interim Report on the problem of flood control on the Naugatuck River and tributaries dated March 1956. Various other reports have also been prepared by town and State agencies.

6. Current Investigations. Current project studies have utilized basic data obtained in previous investigations, and the following new data has been developed:

a. Photogrammetric maps, developed for highway relocation in the area, have been checked for accuracy by selected field cross sections and found to be sufficiently accurate for area capacity computations and reservoir mapping. A new topographic survey was obtained for the dam construction site.

b. Geological and soils investigations of foundation conditions and embankment materials have been undertaken, and potential sources of concrete aggregates in the vicinity of the project have been investigated.

c. Hydrological studies have been made to determine spillway design flood, outlet requirements and reservoir capacity.

d. Preliminary appraisals of land acquisition costs in the reservoir and work areas have been made.

e. Relocation and alteration of railroad, roads and utilities within the reservoir area have been discussed with the owners or controlling agencies and preliminary studies completed.

7. Coordination with Other Governmental Agencies.

a. U. S. Bureau of Public Roads. The Division Engineer of the U. S. Bureau of Public Roads reports in letter of 7 February 1957 that there are no Federal-aid routes affected by the Hancock Brook Dam. He has further advised by letter dated 29 November 1961 that use of the dam as a public highway bridge is not economically desirable nor needed as a link in the State and Federal highway systems.

b. Federal Power Commission. The Regional Engineer of the Federal Power Commission, in letter dated 3 October 1961, has advised that in view of the small drainage area controlled and the absence of dependable flow and head, it is concluded that power development in conjunction with flood control at the proposed Hancock Brook project would not be practicable nor economically feasible.

c. Public Health. The Regional Engineer of the U. S. Department of Health, Education and Welfare, Public Health Service, in letter dated 30 January 1957, advises that the overall effects of the project should be beneficial from a mosquito control standpoint. This aspect is discussed more fully in Section V, Public Health, of this memorandum.

d. Fish and Wildlife Resources. Coordination with State and Federal fish and wildlife agencies will be continued through the planning, construction and real estate phases of the project. This aspect is summarized in Section W, Fish and Wildlife Resources, and in a letter report dated 25 April 1960, from the Regional Director of the U. S. Fish and Wildlife Service, which is reproduced in Appendix A of this design memorandum.

e. National Park Service. In letter dated 23 May 1958, the Regional Archeologist of the National Park Service has indicated that archeological salvage may be involved at the project site, but that definite information must await survey.

f. State of Connecticut, Water Resources Commission. The Director of the Water Resources Commission, State of Connecticut, in letter dated 3 June 1958, concerning the four

proposed flood control dams located on tributaries of the Naugatuck River below the Thomaston Dam, states that the commission approves of the construction of these dams and hopes that every step will be taken to expedite their design and construction.

8. Public Hearings. A public hearing was held on 11 December 1956 in Waterbury, Connecticut, to determine the need for additional projects for flood control and allied purposes on the Naugatuck River, Housatonic River Basin, Connecticut.

E. LOCAL COOPERATION

9. Local Cooperation. The Act which authorizes Hancock Brook Dam and Reservoir does not require local cooperation in connection with its construction. The dam and reservoir, therefore, will be constructed wholly with funds of the United States. Local cooperation is, however, required to the extent that the channels downstream of the dam be zoned to prevent encroachment harmful or detrimental to the reasonable, efficient operation of the reservoir. The State of Connecticut has established such encorachment lines on the main stem of the Naugatuck River. In letter dated 22 September 1961, the Director, State of Connecticut, Water Resources Commission, has also provided assurance that additional encroachment lines will be established along Hancock Brook between the dam site and the Naugatuck River to fulfill the total requirement.

F. LOCATION OF PROJECT

10. Location of Project. The Hancock Brook Dam and Reservoir project is located in west-central Connecticut, 4.5 miles north of the center of Waterbury, on Hancock Brook 3.25 miles upstream of its confluence with the Naugatuck River. The dam and reservoir are located entirely within the boundaries of the Town of Plymouth, Connecticut. The relation of the proposed project with respect to other flood control projects in the Housatonic River Basin and to the surrounding area is shown on Plates Nos. 3-1 and 3-2.

11. Description of the Naugatuck River Watershed. The Naugatuck River Watershed, the largest subbasin of the Housatonic River Basin, is located in western Connecticut, primarily within

the confines of Litchfield and New Haven Counties. It extends from Derby, Connecticut, 50 miles northerly to the towns of Norfolk and Winchester with a maximum width of 12 miles.

G. RECOMMENDED PROJECT PLAN

12. Recommended Project Plan. The recommended project plan for the Hancock Brook Reservoir includes the construction of: (1) a dam on Hancock Brook 3.25 miles above its confluence with the Naugatuck River; (2) an ungated outlet works founded on rock in the right abutment; (3) a spillway adjacent to the right abutment of the dam; (4) approximately 0.8 miles of relocated town road; (5) approximately 2.0 miles of relocated single-track line of the New York, New Haven and Hartford Railroad together with associated dike; and (6) the relocation of affected power and telephone lines.

H. DEPARTURES FROM PROJECT DOCUMENT PLAN

13. Project Document Plan. The Hancock Brook project is authorized under the Flood Control Act of 14 July 1960, in general accordance with the plan presented in House Document No. 372, 86th Congress. This plan proposed flood control storage of 3,820 acre-feet at spillway crest elevation 484, equivalent to 6.0 inches of runoff from the tributary drainage area of 12.0 square miles.

14. Departures from Project Document Plan. The following modifications and changes from the approved document plan result from further detailed studies based on additional investigation and information.

a. The dam site has been shifted approximately 300 feet downstream from the project document site to better utilize existing topography, to reduce required spillway excavation and to obtain a more favorable outlet conduit alignment in rock.

b. The top elevation of the dam has been raised from elevation 499 to 505, m.s.l., due to spillway modifications described below.

c. The spillway length has been reduced from 145 feet to 100 feet, and a simple concrete sill substituted for the ogee weir. The savings resulting from this change more than offset

the cost of raising the dam crest an additional 6 feet to elevation 505, as necessitated by the change.

d. The conduit has been changed from a round precast shape 4'-0" in diameter to a 3'-0" x 4'6" rectangular shape poured directly against rock in a line-drilled trench. This will provide maximum control of the rock excavation and a reduced concrete section.

e. An access berm has been added on the upstream face of the dam to permit passage of wheeled vehicles to the intake structure for ordinary maintenance and debris clearing operations.

f. The highway relocation plan has been revised so the portion of Waterbury Road which crosses the reservoir and dam site areas will be replaced by a more direct route. The revised alignment passes the left abutment of the dam, thereby eliminating the need of the dam site access road shown on the document plan.

g. The composition of the dam embankment has been modified to that of an earth fill dam in lieu of the predominantly rock fill section shown in the document plan. This is the result of a substantial reduction in required spillway rock excavation and the availability of earth from required highway and railroad excavations.

I. HYDROLOGY

15. Spillway Design Flood. The spillway design flood represents the most severe condition of runoff that would result from the probable maximum precipitation over the watershed falling on ground saturated from previous rains. Concurrently it is assumed that the reservoir is filled to spillway crest as a result of previous storms and that the outlet is inoperative. The probable maximum precipitation over the watershed amounts to 24.0 inches in 24 hours with 19.8 inches occurring in a 6-hour period. Infiltration, surface detention and other losses are assumed at the rate of 0.05 inch per hour, resulting in a total rainfall excess of 22.8 inches. The adopted spillway design flood with a peak value of 20,700 c.f.s. is constructed by applying the rainfall excess to the adopted unit hydrograph.

A maximum spillway discharge of 16,600 c.f.s., with a maximum water surface elevation of 499.7 feet, m.s.l., or a spillway crest surcharge of 15.7 feet, is derived by routing the spillway design flood through the reservoir.

16. Channel Capacity. The safe channel capacity immediately downstream of the dam is estimated to vary between 350 and 400 c.f.s. With the reservoir at spillway crest elevation, it is estimated that the uncontrolled outlet discharge will amount to 377 c.f.s.

17. Flood Control Outlet. A single 3'-0" x 4'-6" uncontrolled conduit will regulate the reservoir outflow so that normal streamflows and minor flood flows will utilize only a small portion of the reservoir storage capacity, so that the uncontrolled discharge from major flood flows will not seriously affect downstream river stages and so that the time required to empty the reservoir after a flood operation will be reasonably short. It is estimated that, assuming average inflow conditions, the entire reservoir will be drained in approximately 9 days and that 80 per cent of the project flood control capacity would become available in about 6 days.

18. Freeboard. A freeboard of 5.3 feet above the maximum surcharge pool elevation of 499.7 is provided resulting in a top of dam elevation of 505.0.

19. Reservoir Capacity. The Project Document Plan as presented in House Document No. 372, 86th Congress, provides for a flood control storage equivalent to 6.0 inches of runoff from the 12.0 square mile tributary drainage area and a spillway crest elevation of 484.0. The recommended project plan retains the same spillway crest elevation, but will provide 6.1 inches of flood control storage as derived from a more accurate photogrammetric survey of the reservoir area. Studies based on the flood of record (August 1955) and the standard project flood show this amount will provide adequate flood protection for downstream communities and that uncontrolled discharge from the reservoir outlet will have a negligible effect on the major downstream damage centers.

20. Spillway Length. Economic studies of spillway lenths of 75, 100, 125, and 150 feet for both the adopted sill crest and a standard ogee weir crest have been made. Factors considered

included spillway, dam embankment, dam outlet works and railroad dike construction costs. The cost of real estate and relocation features other than the railroad dike are not significantly affected by varying heights of spillway surcharge. The 100-foot spillway with a concrete sill crest yielded the lowest total project cost and has therefore been adopted.

J. GEOLOGY

21. General. The Hancock Brook Reservoir Project is located in the western Connecticut highlands, an area of plateau remnants sloping gently to the southeast. The area presents a moderate relief controlled by Paleozoic and older crystalline rocks overlain by varying depths of glacial deposition.

22. Site Geology. Hancock Brook at the dam site flows on alluvial deposits of gravels, sands and silts in a restricted channel approximately 175 feet wide. The left abutment of the dam is formed by a smoothly contoured, outwash mantled, drumloidal shaped hill which is separated from the easterly side of the valley by a sharp, indicated fault controlled defile presently containing Greystone Road. Bedrock outcrops infrequently on the right abutment through a thin mantle of glacial outwash.

23. Bedrock Characteristics. Bedrock, generally a highly micaceous schist, is exposed in limited outcrops along the right abutment of the dam and along the sides of the saddle containing Greystone Road. The rock is generally weathered to depths of 5 to 10 feet below the ground surface and displays a distorted foliation dip of 25° to 30° to the northwest. Spillway and outlet works structures have been located in rock in the right abutment. Structure and channel excavations will be taken below the most severe zones of weathering. Low water losses during pressure testing of borings along the center line of the dam indicate that take of grout will be nominal.

The railroad will be relocated through the saddle east of the dam where a fault zone is indicated. Design of excavation slopes through the saddle will depend on the trend and width of this zone of weak and crushed rock.

K. ALTERNATE PLANS

24. Other Plans Investigated. a. General. A section of the proposed railroad relocation passes through a narrow saddle occupied by Greystone Road approximately 1,000 feet east of the dam. Railroad grade limitations will require excavation of the saddle floor to a maximum depth of 45 feet. Early subsurface explorations have shown that drainage controls and slope criteria in this and other railroad cut sections should be based on conservative assumptions because of the nature of the encountered material. The volume and quality of required excavation and the overall length of the railroad therefore combine to make the railroad relocation the most costly feature of the project. Alternate project investigations have consequently sought more economical railroad relocation routes in an effort to reduce overall project costs. The various plans investigated are as follows:

b. Railroad Tunnel. Investigations were made for a railroad alignment requiring a tunnel, approximately 1,500 feet long, through the drumloidal shaped hill which lies between the dam site and the narrow saddle occupied by Greystone Road. Tunneling costs plus heavy rock excavation in the vicinity of the tunnel portals, however, result in excessive railroad relocation costs.

c. Railroad Alignment Through Dam. Estimates were prepared for raising the railroad on its existing alignment through the dam embankment and providing a gate or stoplog structure at the dam to be closed during periods of reservoir operation. Railroad grade requirements limit the maximum railroad elevation at the dam to approximately elevation 477 which would necessitate gate operation and interruption of rail traffic whenever the reservoir stage approaches the five-year frequency of filling level. This limitation together with the possibility that the dam might be breeched due to maloperation of the gate led to the rejection of this plan in spite of an indicated saving of approximately $100,000.

d. Upstream Dam Site. Preliminary investigations and estimates were made to determine the feasibility of shifting the dam location approximately 1,800 feet upstream from the recommended site. Such a shift when combined with a maximum grade raising of the railroad downstream of the dam permits the railroad to pass the easterly abutment at top of dam elevation.

It further permits the selection of a railroad alignment along the eastern slope of the brook valley which avoids the heavy cuts encountered in the narrow saddle now occupied by Greystone Road. The savings resulting from the more economical railroad alignment are, however, more than offset by the increased cost of dam and highway construction required by the upstream site which results from the additional valley width at this location.

L. DESCRIPTION OF PROPOSED STRUCTURE AND IMPROVEMENTS

25. General. The project plan provides for the construction of a rolled-earth fill dam with rock slope protection, an ungated outlet works founded on bed rock and a chute spillway excavated in earth and rock at the western end of the dam embankment.

26. Embankment. The embankment will be of rolled-earth fill construction with rock slopes for protection of the surface against erosion and wave action. The top of the dam at elevation 505.0 will extend for a length of 630 feet across the stream valley and have a maximum height of 57 feet above the stream bed. The top width will be 20 feet except for a length of 50 feet on the spillway side where a 40-foot width is provided for turn-around purposes. Final upstream and downstream embankment slopes, foundation treatment and delineation of interior zones of material will be presented in Design Memorandum No. 6, "Embankment and Foundations."

27. Outlet Works. a. General. The outlet will be located on the right bank and founded on bedrock. It consists of an excavated inlet channel; an intake structure to control the level of a wildlife management pool; a conduit under the dam embankment; an outlet structure; and an excavated outlet channel.

b. Inlet Channel. The inlet channel, excavated in earth and rock, will be approximately 325 feet long, with a bottom width of 12 feet and side slopes of one vertical on two horizontal in earth. Rock side slopes are four vertical on one horizontal. The invert elevation is at 454.0 m.s.l.

c. Intake Structure. The intake structure founded on rock, provides a reinforced concrete control weir with crest at elevation 458.0 m.s.l. Stoplogs are provided to raise the

pool level to elevation 460.0 m.s.l. for vegetation control or wildlife management. A 2'-0" x 2'-0" sluice gate is also provided in the upstream face of the weir to permit dewatering of the management pool.

d. Conduit. The conduit will be 247 feet long, including an 8-foot transition section at the intake structure. It will be of reinforced concrete, with a cross section area of 13.5 square feet, and extend from the intake structure to the outlet structure.

e. Outlet Structure. The outlet structure will consist of a concrete headwall and apron founded on bedrock with an invert elevation of 451.0. The apron will extend 25 feet from the conduit mouth to support and spread the discharge as it approaches the trapezoidal shaped outlet channel. If, upon excavation, the rock side slopes are determined to be unsound, concrete side walls, anchored to the rock face, will also be added to the outlet structure.

f. Outlet Channel. The outlet channel, approximately 600 feet in length, will be excavated in earth and rock, with a bottom width of 14 feet. Rock slopes will be 4 vertical on 1 horizontal, and earth slopes will be 1 vertical on 2 horizontal. The outlet channel will entirely contain the conduit discharge within rock section for a distance in excess of 100 feet below the concrete apron thereby eliminating the need for a stilling basin.

28. Spillway. The spillway will be located adjacent to the right abutment of the dam and separated from it by a small concrete retaining wall. It will be a channel 850 feet long, 100 feet wide, cut in earth and rock, with a crest at elevation 484.0. The channel slope upstream of the crest is 1%, and the downstream slope is 10%, flattening to 1%. The crest will be a flat concrete sill embedded in rock at the high point of the channel. Excavated materials from the spillway will be used in the dam embankment to the greatest extent possible.

29. Reservoir Clearing. Clearing, if required, of that portion of the reservoir area below the wildlife management pool will be accomplished by the using agency.

30. Staff and Recording Gages. A series of staff gages and a recording gage of the bubbler type will be provided for

the reading and recording of reservoir stages. In order that releases from the Thomaston Dam and Reservoir may be coordinated with the discharge of the Hancock Brook project, it is planned to provide for the transmission of reservoir stage data by radio telemetric means.

31. Administrative Facilities and Utilities. No administrative facilities will be provided as the project will be unattended. Maintenance and operation will be accomplished by Government personnel stationed at the Thomaston project. Commercial and stand-by electric power will be provided for the operation of the reservoir gage radio in the event that a battery powered unit is not feasible.

M. ACCESS ROADS AND RAILROAD FACILITIES

32. Highways. The site is located on Waterbury Road which will be relocated. The relocated highway will be adjacent to the east dam abutment and will serve as the main access road. Access will be limited for official use only. Access to the reservoir area will be obtained by existing roads within the project area.

33. Railroad Facilities. The site is located on a New York, New Haven and Hartford Railroad single track line which runs from Waterbury to Bristol, Connecticut. The nearest unloading facilities are in Waterbury.

N. USE OF CONSULTANTS

34. Use of Consultants. The Hancock Brook Reservoir Project imposes no complex design problems. Copies of this memorandum, however, will be submitted to Mr. Arthur Casagrande and Mr. Frank Fahlquist, Consulting Engineers, both of whom are retained by this Division on a continuing basis, for their review and comments.

O. SOURCES OF CONSTRUCTION MATERIALS

35. Materials for Earth Embankment Construction. It is anticipated that materials for construction of earth embankment will be obtainable from required excavations in the relocation projects and from an impervious borrow area immediately south of the dam site.

Pervious materials will be available from commercial sources within the reservoir which are now being operated to produce concrete aggregates.

36. Materials for Rock Protection. Rock excavation in the dam site area will be utilized insofar as possible for embankment slope protection. Additional quantities, as required, will be obtained from areas of relocation features. It may be necessary to selectively stockpile and perhaps process rock from some areas of excavation to obtain rock of adequate quality.

37. Concrete Aggregate. Aggregate studies made in conjunction with other projects recently completed and under construction in the immediate area have proved that satisfactory material can be obtained from commercial sources within a 25-mile radius.

P. REAL ESTATE

38. Area Description. The Town of Plymouth, which has an area of 22.2 square miles, is divided into three districts: Plymouth, which is the location of the project area; Terryville, and Pequabuck. Of the three villages, Terryville has developed to the greatest extent due to its central location, neighborhood stores, and its proximity to industrial development. During the past 100 years, the population of the town has increased from 6,000 to 9,000. This steady trend of growth is expected to continue because of the location of manufacturing concerns within the town and in nearby areas. The area is growing at a fairly level rate as evidenced by a steady demand for homesites, and this moderate demand is expected to continue in the foreseeable future.

The project area consists of a narrow, cleared valley flanked by a series of wooded, rocky hills, which rise quite sharply. Development in the valley area of the project is, for the most part, residential. There are also two large active sand and gravel operations and one farm property. All of the land within the project area is zoned for residential use. The Town of Plymouth adopted zoning regulations in 1960, which now require minimum lot areas of 40,000 square feet and minimum frontages on a paved road of 150 feet. Prior to the adoption of zoning regulations, no minimum lot size was required which accounts for the smaller size of many of the improved homesites that exist in the taking area. Generally, the improve homesites

within the purchase area range in size from 0.06 acre to 1.25 acres, and the average area per lot is about 0.5 acre. The estimated total area for improved homesites used in this report is based upon an 0.5 acre of land per homesite.

39. Land Acquisition Requirements. The minimum guide taking line has been established at 490 feet m.s.l. Fee title will be acquired over land needed for construction, permanent structures, borrow areas, highway and railroad relocations, and the reservoir area. It is also proposed to acquire fee title to a considerable amount of acreage on the inclosing ridges and hills which form the westerly side of the reservoir since the proposed acquisition will sever access to remainders. Similarly, it is also proposed to acquire in fee approximately 100 acres of land located on the easterly side of Todd Hollow Road. This road will be encumbered by a flowage easement; and during periods of flooding, properties located along this road will not have access. If at the time of acquisition, owners of these properties desire to retain this rear acreage and if the project requirements are not affected thereby, consideration for eliminating this land will be given. The total acreage and cost of land for the project will be reduced accordingly.

The total estimated fee area is 872 acres, which includes 76 acres for dam site, borrow area, and highway and railroad relocation requirements. An access road easement, consisting of about one acre, will also be required to provide access to the borrow area.

40. Relocations. Current planning includes relocation of a section of Waterbury Road and a section of the New York, New Haven and Hartford Railroad. Todd Hollow Road will remain in place subject to a flowage easement which will prevent all weather access. Included in the total real estate cost is an estimate of $20,000 for three acres of land and one residential unit located outside the limits of the project area required for the Waterbury Road relocation, and $70,000 for 26 acres of land and four residential units required to relocate the railroad right of way. Telephone and electric distribution lines within the project will either be abandoned, raised in place or relocated along existing or new rights of way. No additional real estate rights for these facilities are anticipated and therefore no land costs are submitted herein.

41. Severance Damage. Under the proposed plan of purchasing in fee to the exterior property bounds where inadequate access will be available to remainders, severance damage should be relatively minor. However, partial takings cannot entirely be avoided, and some damage of this nature is likely to occur. At the present time, with only a general knowledge of individual property bounds, it is estimated that damages of this nature will approximate $5,000.

42. Water Rights, Minerals and Crop Damages. With the exception of an estimated 60 acres of sand and gravel land, there are no known deposits of minerals having special value. No crop damage is contemplated since it is planned to acquire the land either prior to or subsequent to the growing season. There are no known water, coal, oil, gas or other rights or interests outstanding within the project area.

The two active commercial sand and gravel operations are located on the west side of Todd Hollow Road. Both owners have been removing material for several years and it is estimated that the sand and gravel deposits are about 30 per cent depleted. The equipment which is used in the processing of the material, such as loaders, graders, crushers and washers, is considered as personal property; and, therefore, its value is not considered in this report.

43. Valuation.

Item	Total Value
Fee Area (872 acres)	$250,000
Improvements (26 residential properties)	294,000
Easements (1 acre)	1,000
Severance Damage	5,000
Acquisition Costs (80 tracts)	76,000
Resettlement Costs	28,500
Subtotal	654,500
Contingencies (15%)	98,175
Total Real Estate Cost	$752,675
Rounded to	$753,000

Q. RELOCATIONS

44. Railroad Relocation. a. General. The Waterbury to Hartford line of the New York, New Haven and Hartford Railroad Company traverses the dam site and reservoir area. The line is single track, for freight only, and besides servicing highly industrial areas is important for the routing of "over-dimension" car-loadings to bypass restrictive clearances on the main line. The attitude of the Railroad is favorable to relocation. The Railroad is also cooperative to the extent that a study, requested 16 June 1961, is being made to determine whether abandonment of the segment at the reservoir is possible without undue loss of the revenue from existing service. Informal word from lower echelon operating officials indicates apparent negative results. Pending receipt of a formal report on the feasibility of abandonment with the Railroad's statement of attitude toward it, relocation of about two miles of the line is proposed.

b. Betterment. As the existing track must be kept in operation during the construction of the relocated line, other track materials must be furnished. Since the rail section in the existing track is obsolete though adequate for its present purpose, and replacement in kind is not available, it is necessary to provide rail of a higher standard section, either used or new as may be available. A similar conclusion is applicable to rail fittings and cross ties. The use of such materials necessitated solely as a result of the relocation does not constitute a betterment cost allocable to the owner. Salvage value of the existing track less cost of removal will be deducted from the Government relocation cost.

c. Contingencies. A contingency factor of 20 per cent has been applied to the estimated railroad construction cost in view of the geological conditions which will be encountered in the railroad cut areas. A more complete description of these conditions is provided in Design Memorandum No. 2, "Site Geology."

45. Highway Relocations. a. General. Roads which are to be raised or relocated within the reservoir area will have a minimum profile grade of elevation 490.0, which is 6 feet above spillway crest elevation and 4.5 feet above the maximum pool elevation under a theoretical recurrence of the August 1955 maximum flood of record. Flowage easements will be obtained

for all road embankments in the reservoir area below the Guide Taking Line, Elevation 490.0. Turn-arounds will be constructed where roads dead end to permit snow removal and maintenance equipment, fire apparatus and school buses to reverse direction.

b. Relocations. Two local roads, Waterbury and Todd Hollow Road, in the Town of Plymouth, Connecticut, are located within the reservoir area. Waterbury Road will be abandoned and a replacement road constructed which will also provide access to the dam. Todd Hallow Road will be kept open under a flowage easement, and a bridge at the southerly end of this road will be raised to maintain required clearance over the railroad which will be raised at this location.

A section of Greystone Road located outside the reservoir area, partly in the Town of Plymouth and partly in the City of Waterbury, will be occupied by the railroad relocation and therefore will be abandoned. A section of Greystone Road, also outside the reservoir area, will be improved to handle the additional traffic which will result from the relocation of Waterbury Road.

46. Utility Relocations. a. Electric Distribution Lines. The Hartford Electric Light Company owns and operates 4,800 volt primary and secondary lines in the reservoir area. Relocations and abandonments are required as follows:

(1) Greystone Road. Relocation of 3,300 feet of 4,800 volt, 3 phase primary from Greystone Road to the proposed Waterbury Road, and relocation of 750 feet of secondary.

(2) Todd Hollow Road. Abandon 8,000 feet of 4,800 volt, 3 phase primary and 700 feet of secondary.

(3) Waterbury Road. Abandon 1,450 feet of 4,800 volt, primary and secondary; and relocate 450 feet of primary by raising to meet new road elevations.

b. Telephone Cables and Rural Lines. The Southern New England Telephone Company owns and operates cables and rural lines in the reservoir area. Relocations and abandonments are required as follows:

(1) Relocate 1,950 feet of pole line with two cables and rural lines along the proposed relocated railroad.

(2) Relocate 1,390 feet of aerial cables from poles to direct burial across the reservoir area.

(3) Relocate 2,025 feet of cable and rural lines from Waterbury Road and Greystone Road to the proposed relocated Waterbury Road.

(4) Abandon 7,300 feet of rural lines along Todd Hollow Road and Waterbury Road.

R. COST ESTIMATES

47. Cost Estimates. The total estimated cost of the project is $2,990,000, which is a net increase of $470,000 over the latest approved project estimate. The cost of lands and damages has increased $305,000 as a result of revised acquisition costs, the inclusion of substantial acreage outside the reservoir due to loss of access to remainders and a more detailed investigation of the factors affecting real estate requirements. The cost of relocations has increased $278,000 as a result of information gained from subsurface explorations along the railroad alignment and the addition of several highway features, including improvement of a portion of Greystone Road, and the raising of a portion of Todd Hollow Road. The cost of dam construction and related features has decreased $175,000 due to elimination of the reservoir clearing and the access road and as a result of modification in the design and location of the dam. Estimated engineering and supervision costs have increased $62,000 as a result of past and anticipated future experience. A summary of the Federal cost of the various features is given in Table I. Further detailed estimates are shown on Table III, following the text of this memorandum.

TABLE I

SUMMARY OF FEDERAL COSTS

January 1962 Price Level

ENR Construction Cost Index 858 (1913 = 100)

Project Feature	Cost	
Lands and Damages	$ 753,000	
Relocations	1,353,000	
Reservoir	3,000	
Dam and Apurtenant Structures	425,000	
Permanent Operating Equipment	4,000	
Sub-Total	$2,538,000	
Pre-Authorization Studies	20,000	
Engineering and Design	270,000	
Supervision and Administration	162,000	
Total Estimated Project First Cost		$2,990,000

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S. SCHEDULE FOR DESIGN AND CONSTRUCTION

48. Design. Preparation of plans and specifications for a single multi-component contract for the dam and appurtenant structures, railroad relocation and highway relocations will be completed in the first half of Fiscal Year 1963.

49. Construction. a. General. Contingent upon Congressional appropriation, a contract for all construction features will be awarded early in the last quarter of FY 1963. The railroad relocation is scheduled for completion in the last quarter of FY 1964, and the highway relocations are to be completed during the first quarter of FY 1965.

Initial phases of dam construction may be started prior to completion of the relocation features, but stream diversion and major dam construction may not start until both

highway and rail traffic can be handled in their new locations. Dam construction is therefore scheduled to begin in the third quarter of FY 1964 and completed in the second quarter of FY 1965. Since much of the dam embankment material will be obtained from stockpiles excavated during the highway and railroad relocation work, and since scheduling of the various components would be difficult to control with individual contracts for the relocation features, it is planned to accomplish the total project under a single multi-component contract awarded in FY 1963.

b. First Construction Season (1963). During the 1963 construction season, the contractor will clear and strip the site and start construction of the highway and railroad relocations. Telephone and electric transmission line relocations will be also accomplish at this time. Rock and earth excavation in excess of the relocation construction requirements will be stockpiled for use in the dam.

c. Second Construction Season (1964). The railroad and highway relocations will be completed during the first part of this construction season; construction of the dam will be initiated early in this construction season, but Hancock Brook will not be diverted until such time as the highway and railroad relocations have been completed. The outlet works, spillway and dam embankment will be constructed and the entire project will be completed during this construction season.

50. Funds Required. The construction schedule takes into consideration the initiation of construction in the spring of 1963. It is therefore estimated that funds will be required by fiscal years approximately as follows:

Fiscal Year	Amount Required
1963	$ 400,000
1964	1,870,000
1965	484,800
Subtotal	$2,754,800
Allotted to date	235,200
Total	$2,990,000

T. RESERVOIR REGULATION

51. Regulation for Flood Control. The Hancock Brook Reservoir will act as an automatic detention basin and, in conjunction with other reservoirs in the Naugatuck River Basin, will desynchronize the peak flows of Hancock Brook from those of the uncontrolled tributaries. Reservoir stage data will be transmitted automatically to the Thomaston Flood Control Dam so that the releases from Thomaston Dam may be coordinated with the outflow of Hancock Brook.

A more detailed description of reservoir regulations is given in Design Memorandum No. 1, "Hydrology and Hydraulics."

U. OPERATION AND MAINTENANCE

52. Operation and Maintenance. The dam and appurtenant structures will be maintained and operated in conjunction with the other flood control reservoirs in the Naugatuck River Basin. Since the project will be unattended, no administrative facilities will be provided at the site. Maintenance and operation will be accomplished by Government personnel stationed at Thomaston Dam.

53. Annual Charges. Estimated annual cost for the operation and maintenance of Hancock Brook Dam is $3,900.

V. PUBLIC HEALTH

54. Vector-Borne Disease Control. Malaria is not known to be of public health importance in Connecticut, and no human cases of eastern equine encephalitis have been confirmed in the State. The overall effect of the project should also be beneficial from a mosquito control standpoint since some swampy areas will be inundated and flooding in downstream areas will be diminished. It is believed no major mosquito problems will be created as a result of the project. In the event such problems should develop, provision will be made for a control program with assistance from both the Connecticut State Department of Public Health and the Public Health Service.

The Regional Engineer of the U. S. Department of Health, Education and Welfare, Public Health Service, in letter

dated 30 January 1957, in commenting on vector problems related to this and other projects under study, has recommended that:

a. The reservoir sites be cleared of all trees and brush.

b. Borrow pits be located, if possible, where they will be permanently inundated.

c. Drainage ditches be provided for the elimination of seepage areas and similar types of ponded water.

d. Flotage, secondary growth, and/or aquatic plants be removed as necessary after impoundment.

e. Provisions be made in the maintenance program for regular and frequent field surveys to determine the amount of mosquito breeding.

f. Provisions be made for chemical measures to control excessive production of mosquitoes, especially during periods of high flood crests.

W. FISH AND WILDLIFE RESOURCES

55. Fish and Wildlife Resources. The U. S. Fish and Wildlife Service has prepared, in cooperation with personnel of the Connecticut Board of Fisheries and Game, a report on the fish and wildlife aspects of four flood control reservoirs on tributaries of the Naugatuck River, in the Housatonic River Basin. Hancock Brook Dam and Reservoir is included therein. The report, dated 25 April 1960, is contained as Appendix A in this memorandum.

The report states that Hancock Brook is an important local trout stream and that the entire reservoir appears to have a high potential value as a fish and wildlife management area, with emphasis on developing the most effective pheasant management program. Benefits will accrue to other game species as well.

As a means of mitigating losses to the recreational and fish and wildlife resources which will result from the operation of the project, provision has been made for the

inclusion of a conservation pool at elevation 460 feet, m.s.l., which has a surface area of 40 acres and a maximum depth of six feet. Control of pool levels is effected by a stoplog structure.

The Board of Fisheries and Game of the State of Connecticut is prepared to undertake management activities under a suitable license agreement.

Detailed discussion of the fish and wildlife program will be contained in Design Memoranda 9A and 9B, Master Plan for Reservoir Development.

X. RESERVOIR MANAGEMENT AND PUBLIC USE

56. Recreation. The Hancock Brook Reservoir, with a shallow pool for wildlife conservation purposes and with a wide marshy area upstream of the dam will provide a highly desirable area for improved public hunting and fishing opportunities. This appears to be the highest and best use of the recreational potential of the project.

The reservoir is located in a populous area of west central Connecticut. The 1960 census showed a population of 1.3 million people within a 25-mile radius of the project. This represents a growth of about 26 per cent over the 1950 census. The number of licensed sportsmen within a 10-mile radius is about 17,000. Pressure is constantly increasing for public hunting and fishing areas.

Determination of the extent and type of basic facilities to be provided for the accommodation of the using public will be made after further consultation with interested Federal and State agencies. The recommended program will then be incorporated in the Master Plan for approval.

Y. ECONOMICS

57. General. The densely populated Naugatuck River Valley is one of the key industrial concentrations in the United States. The Valley's industries produce about 40% of the country's brass, and bronze industrial shapes and a large part of the aluminum, zinc, and copper products.

The destructive flood of August 1955, caused damages of $194,000,000 in the reaches of the Naugatuck River below

Thomaston Reservoir. Thirty-six lives were lost. A recurrence of this flood under today's economic conditions and with Thomaston Reservoir and Waterbury local protection in operation would cause losses estimated at $53,500,000. The Hancock Brook project, acting after Thomaston Reservoir and in a system with three other authorized reservoirs, Northfield Brook, Black Rock and Hop Brooks, would prevent $7,500,000 in losses in such a recurrence.

58. Annual Benefits. Annual benefits were derived by determining the difference between annual losses remaining after operation of Hall Meadow and East Branch Reservoirs and local protection at Waterbury, all built or under design, and those remaining after operation of the above-mentioned reservoirs acting as a system with Hancock Brook receiving an equitable share of the benefits. Annual losses, before and after the project, were adjusted to reflect the growth expected to occur in the areas of project influence over the hundred-year life of the project. Average annual benefits so derived amount to $210,000 at present day price level.

Assuming that Hancock Brook is the last added project in a system of seven reservoirs and a local protection project the annual benefit is $163,000.

59. Annual Costs. Annual costs are shown in Table II, below:

TABLE II

ANNUAL COST

Financial Investment	
Total Federal First Cost	$2,990,000
Interest During Construction (1 year @ 2-5/8%)	78,490
Total Financial Investment	$3,068,490

(TABLE II, ANNUAL COST - Contd)

Financial Annual Cost	
Interest on Financial Investment (2-5/8%)	$ 80,550
Amortization of Financial Investment (100 years @ 0.213%)	6,540
Maintenance and Operation	3,910
Total Financial Annual Cost	$ 91,000
Economic Annual Cost	
Financial Annual Cost	$ 91,000
Tax Loss on Land (Non-Federal)	7,000
Total Economic Annual Cost	$ 98,000

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60. Benefit-Cost Ratio. The economic annual cost, as shown in Table II above, is $98,000. Assuming the project is the last of a system of seven reservoirs and one local protection project, the estimated ratio of annual benefits to costs is 1.7 to 1.0. Assuming the project shares equitably in the benefits of the last four reservoirs to be added to the seven reservoirs and one local protection project system, the estimated ratio of annual benefits to costs is 2.1 to 1.0.

Z. RECOMMENDATION

61. Recommendation. It is recommended that the project plan submitted in this memorandum be approved as the basis for preparation of contract plans for the Hancock Brook Dam and Reservoir project.

TABLE III

DETAILED COST ESTIMATES

January 1962 Price Level

ENR Construction Cost Index 858 (1913=100)

1. LANDS AND DAMAGES $ 753,000

2. RELOCATIONS

a. Highway

i) Waterbury Road Relocation	$252,000
ii) Waterbury Road Raising	10,000
iii) Waterbury Road Culvert	15,000
iv) Greystone Road Improvement	23,000
v) Todd Hollow Road Raising	32,000
Contingencies (15%)	$50,000
Sub-Total	$382,000

b. Electric Distribution Lines $ 21,000

c. Telephone Cables and Rural Lines $ 31,000

d. Railroad

Description	Quantity	Unit Price	Amount
Preparation of Site	1 Job	L.S.	$ 5,200
Unclassified Excavation	238,200 c.y.	0.75	178,650
Rock Excavation	57,900 c.y.	3.00	173,700
Dike Fill	34,000 c.y.	0.30	10,200
Embankment Fill	87,000 c.y.	0.30	26,100
Rock Slope Protection	11,300 c.y.	2.00	22,600
Gravel Bedding	7,200 c.y.	1.25	9,000
Topsoil	1,100 c.y.	2.50	2,750
Seeding	3 Ac	350.00	1,050
Drainage Structures	1 Job	L.S.	55,500
Cribbing Walls	3,450 S.F.	9.00	31,050
Track and Ballast	1 Job	L.S.	250,000
Contingencies (20%)			153,200
Sub-Total			$919,000

TOTAL RELOCATIONS $1,353,000

3. RESERVOIR $ 3,000

4. DAM

Description	Quantity	Unit Price	Amount
Preparation of Site	1 Job	L.S.	$ 8,700
Diversion & Care of Brook	1 Job	L.S.	21,000
Unclassified Excav.,General	61,500 c.y.	.75	46,125
Unclassified Excav.,Borrow	72,700 c.y.	.75	54,525
Line Drilling	3,560 S.F.	3.00	10,680
Rock Excavation, General	15,500 c.y.	2.50	38,750
Rock Excavation, Outlet Works	3,500 c.y.	3.00	10,500
Gravel Bedding	15,800 c.y.	1.25	19,750
Compacted Embankment Fill	104,300 c.y.	.20	20,860
Additional Embankment Rolling	200 hr.	15.00	3,000
Rock Fill Slope Protection	16,000 c.y.	2.00	32,000
Compacted Backfill	3,200 c.y.	1.50	4,800
Foundation Grouting	1 Job	L.S.	40,000
Concrete, Outlet Works	465 c.y.	50.00	23,250
Concrete, Spillway	90 c.y.	35.00	3,150
Portland Cement	830 bbl.	5.00	4,150
Steel Reinforcement	56,000 lbs.	.15	8,400
Miscellaneous Metals	1,400 lbs.	.75	1,050
Shelter for Stage Recorder	1 Job	L.S.	6,000
Sluice Gate	1 Job	L.S.	4,000
Highway Guard Rail	1,200 L.F.	2.50	3,000
Chain Link Fencing	1,400 L.F.	3.00	4,200

4. DAM (cont'd)

Topsoiling	300 c.y.	2.50	750	
Seeding	0.5 Acre	500.00	250	
Monument	1 Job	L.S.	500	
Contingencies 15%			55,610	
TOTAL DAM				$ 425,000
5. PERMANENT OPERATING EQUIPMENT				$ 4,000
TOTAL CONSTRUCTION COST				$2,538,000
6. INDIRECT COSTS				
a. Pre-Authorization Studies		$ 20,000		
b. Engineering		270,000		
c. Supervision and Administration		162,000		
				452,000
TOTAL PROJECT FIRST COST				$2,990,000

APPENDIX A

Report of the U. S. Department of the Interior, Fish and Wildlife Service

STATE OF CONNECTICUT
BOARD OF FISHERIES AND GAME
2 Wethersfield Avenue
Hartford, Connecticut

C
O
P
Y

March 17, 1960

Mr. John S. Gottschalk
Regional Director
Fish and Wildlife Service
59 Temple Place
Boston, Mass.

Dear Mr. Gottschalk:

This Department has completed its review of the draft copies of the fish and wildlife reports pertaining to the Upper Naugatuck River Basin projects and the Hall Meadow Brook Reservoir project.

These reports, including their conclusion and recommendations, have my complete endorsement and we are willing to accept the responsibilities inherent in the execution of a General Plan.

Sincerely yours,

/s/ Lyle M. Thorpe
Director

AL/B

ADDRESS ONLY THE
REGIONAL DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
59 TEMPLE PLACE
BOSTON, MASSACHUSETTS

NORTHEAST REGION
(REGION 5)
MAINE
NEW HAMPSHIRE
NEW YORK
VERMONT
PENNSYLVANIA
MASSACHUSETTS
NEW JERSEY
RHODE ISLAND
DELAWARE
CONNECTICUT
WEST VIRGINIA

April 25, 1960

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts

Dear Sir:

This letter constitutes our report on the fish and wildlife aspects of 4 proposed flood control reservoirs on the Naugatuck River in Litchfield and New Haven Counties, Connecticut. These sites include Black Rock, Hancock Brook, Hop Brook and Northfield Brook, none of which have been authorized. This report has been reviewed by the Connecticut State Board of Fisheries and Game. The report, and specifically the recommendations which follow, have been endorsed by the Connecticut State Board of Fisheries and Game as indicated in the letter to me dated March 17, 1960, from Director Lyle M. Thorpe of that Board, a copy of which is appended.

Comments were previously submitted concerning these and other sites in our letters of December 14, 1956, and May 22, 1958.

The 4 projects under consideration are located on tributaries to the Naugatuck River, in the Housatonic River Basin. The tributaries enter the Naugatuck downstream from the Thomaston Dam and Reservoir currently under construction. None of the proposed sites are farther than 9 miles from the city of Waterbury, the largest population center in this highly industrialized and urbanized basin.

DESCRIPTION OF FISH AND WILDLIFE RESOURCES IN RELATION TO PROJECT PLAN

Hancock Brook Dam and Reservoir

Project Plan

The Hancock Brook Dam site is located in the town of Plymouth 3.4 miles upstream from the confluence of Hancock Brook and the

Naugatuck River. At the spillway crest elevation of 484 feet,[1/] the flood pool will have a surface area of about 265 acres. The dam will be 50 feet high, 615 feet long and will store 3,820 acre-feet of water. The 5-year flood pool at elevation 475 feet will have a surface area of approximately 200 acres. The dam will be provided with a 48-inch ungated conduit. The surcharge elevation will be 10 feet above the spillway.

Fish and Wildlife Resources (Without the Project)

Hancock Brook is an important local trout stream. The State Board of Fisheries and Game stocks this stream annually with large numbers of trout. In 1959 a total of 1,450 yearling, and 25 2-year-old brook trout, 500 2-year-old brown trout, and 75 2-year-old rainbow trout were stocked. This fishery resource provides about 3,000 angler-days of recreation every year.

The reservoir area differs from the other 3 projects in that it encompasses a large area of brushy swampland. Almost the entire area offers good to excellent habitat for cottontail rabbit and pheasant. Lesser amounts of habitat are available for waterfowl, grouse, woodcock, squirrel, mink and muskrat. The State regularly stocks pheasant in the site and in 1959, 125 adult birds were released. About 2,000 hunter days are expended in harvesting the stocked pheasants and the other resident and migratory game species.

Fish and Wildlife Resources (With the Project)

Periodic flooding within the reservoir area will inundate long reaches of streams within the site due to the low gradient of the basin. Over 2.8 miles of Hancock and Todd Hollow Brooks will be inundated whenever the reservoir reaches the spillway crest elevation. Every year a total of about 2 miles of streams will be inundated and 2.4 miles will be inundated every 5 years. It is expected that the trout habitat within the stream mileage annually inundated will be depreciated considerably in value. Streams encompassed in flood storage pools to be held at less frequent intervals will suffer less damaging effects. Trout habitat below the dam site will suffer some temporary damages from siltation during project construction.

The anticipated annual flood pool will inundate about 130 acres of good small game habitat. Every 5 years, about 200 acres will be inundated and at the spillway crest elevation, about 265 acres will be inundated. Some changes in the vegetative composition

1/ All elevations in this report are in feet and refer to mean sea level datum.

resulting from inundation can be expected, but this change will probably be minimal within the 1-year level since existing vegetation is adapted to a certain amount of flooding. Indiscriminate borrow operations would cause more serious losses to the wildlife resource at Hancock Brook than at any of the other reservoir sites.

Northfield Brook Dam and Reservoir

Project Plan

The Northfield Brook Dam site is located 1 mile upstream from the confluence of Northfield Brook and the Naugatuck River in Thomaston. The 118-foot high dam will be approximately 800 feet long and is designed to store 2,430 acre-feet of water. A pool held at spillway crest elevation of 573 feet will have a surface area of about 60 acres. The spillway is designed for a 10-foot surcharge. The 5-year flood pool will have a surface area of about 35 acres at elevation 540. Control of the reservoir will be accomplished by means of a 36-inch ungated conduit.

Fish and Wildlife Resources (Without the Project)

Northfield Brook is a locally important trout stream and receives moderate angling pressure. The stream is stocked annually by the State. In 1959, 150 yearling brook trout were stocked and these were supplemented by some natural reproduction in the stream.

The 60-acre reservoir area provides very limited habitat for small game species, due to present land uses and the proximity to the highway. Hunting pressure on the area is negligible.

Fish and Wildlife Resources (With the Project)

At the spillway crest elevation the reservoir pool will inundate 1.2 miles of Northfield Brook. Every year approximately a $\frac{1}{2}$ mile of stream will be inundated and about 0.6 mile will be inundated every 5 years. Periodic flooding will result in direct losses to the production and utilization of the fishery resource.

Potential wildlife production and utilization with the reservoir area will be detrimentally effected. Changes in vegetative composition can be expected, more notably in the lower most frequently flooded portions of the reservoir, which will influence utilization by wildlife species.

Hop Brook Dam and Reservoir

Project Plan

The Hop Brook dam site is located on Hop Brook in the town of Middlebury about 1.2 miles upstream from the confluence of Hop Brook and the Naugatuck River. A small portion of the reservoir area at the dam site lies within Whittemore Glen State Park.

The proposed dam will be approximately 470 feet long, 82 feet high and will store 6,840 acre-feet of water. The surcharge elevation will be 10 feet above the spillway crest. At spillway crest elevation of 362 feet, the surface area of the flood pool will be about 280 acres. Flows through the 48-inch conduit will be controlled by means of 2-3 X 3 foot hydraulically operated gates. The 5-year flood pool at elevation 342 feet would inundate about 150 acres.

Fish and Wildlife Resources (Without the Project)

Hop Brook is considered a locally important trout stream and is stocked annually. In 1959, the State released 1,400 yearling brook trout, 25 2-year-old brook trout and 150 2-year-old brown trout. It is estimated that the stream provides 2,250 angler-days of recreation annually

The partly wooded reservoir area provides high quality small game habitat and involves lands where the State Board of Fisheries and Game has hunting agreements with landowners. These occur at the upper part of the reservoir site and form part of the Naugatuck Regulated Shooting Area. Despite some posting against access, the project area provides a total of about 1,220 hunter-days recreational annually, about three quarters of this hunting effort being expended in harvesting rabbit, woodcock, grouse, and squirrel. The remainder is accounted for by hunters seeking pheasant which are stocked by the State.

Fish and Wildlife Resources (With the Project)

The reservoir pool at spillway crest elevation would inundate about 1.6 miles of Hop Brook, 0.8 mile of Wooster Brook and 0.3 mile of Welton Brook. Every year, the flood pool is expected to reach an elevation which will inundate 1.2 miles of Hop Brook and 0.5 mile of Welton and Wooster Brooks. Construction activities, annual flooding, and the permanent pool will eventually cause the loss of some, if not all, of the trout angling opportunities now existing.

Flooding to the spillway crest is expected only infrequently; therefore upper elevation areas, including that part of the Naugatuck Regulated Shooting Area within the site, will be subject to minor effects. Frequent flooding to lower elevations will result in more apparent changes in vegetative cover and use by wildlife. Production of wildlife species will be adversely affected, utilization of habitat will be restricted and hunter utilization of this resource will be limited because of flooding at various seasons of the year. Annually, about 90 acres will be flooded and approximately 150 acres will be inundated every 5 years. State Park lands, where hunting is prohibited, accounts for about 14 acres at the annual flood pool area and 20 acres at the 5-year level.

Black Rock Dam and Reservoir

Project Plan

The dam site for the Black Rock project is located on Branch Brook, 1.8 miles upstream from its confluence with the Naugatuck River in Thomaston. Over 70 percent of the reservoir area will lie within the boundaries of Black Rock State Park. A dam 153 feet high and approximately 1,100 feet long will store 8,860 acre-feet of water. At the spillway crest elevation of 513 feet, the reservoir will have a surface area of 180 acres. The 5-year flood pool will have a surface area of 115 acres at elevation 477. Operation of the dam will be accomplished by means of a 54-inch conduit with 2-3 foot by 4 foot hydraulically operated gates. The spillway is designed for a 15-foot surcharge.

Fish and Wildlife Resources (Without the Project)

Branch Brook is considered an excellent trout stream. The Fish Division, of the Connecticut State Board of Fisheries and Game, is using sections of this stream as a study area. In 1959 the stream was stocked with 575 yearling brook trout and 200 2-year-old brown trout. Natural brown trout reproduction provides additional fish for the angler. The fishery resource provides approximately 1,500 angler-days of recreation annually.

Hunting is prohibited in Black Rock State Park, and since the major portion of the reservoir area is State Park land the very small acreage open to hunting receives light pressure. The greater part of the reservoir area is forested and provides good habitat for grouse, squirrels and rabbit.

Fish and Wildlife Resources (With the Project)

At the spillway crest elevation the reservoir will inundate 1.3 miles of Branch Brook. Slightly over a mile of stream will be inundated by the annual flood pool which will be 74 feet deep at the dam. Periodic inundation will result in losses to the stream fishery through siltation, and prevention of angling for short periods of time during and after the flooding period.

DISCUSSION

The Naugatuck River Basin has a population greater than 215,200, of which 90 percent live in urbanized areas of the 5 cities and 28 towns. As an indication of the demands placed on the fish and wildlife resources of the project area, the number of licensed sportsmen within a 10-mile radius of each site averages about 15,000, expending about 77,000 man-days afield annually. Under existing conditions, the project areas meet about 3 percent of this demand, with

the Hop Brook and Hancock Brook areas bearing the greater share of use. If recommendations contained in this report are followed, it is expected that the reservoir areas will be able to meet the maximum possible share of the local demand.

It is understood that the planning agency is recommending the inclusion of permanent pools at each site. At Hancock Brook, a permanent pool at elevation 460 would provide a surface area of 54 acres 6 feet deep at the dam. A large portion of this pool would be less than 3 feet deep. A permanent pool at Northfield Brook would be held at elevation 497 and have a surface area of 7.5 acres 25 feet deep at the dam. At Hop Brook, a permanent pool at elevation 310 would have a surface area of 25 acres and be 14 feet deep at the dam. At elevation 420, a permanent pool at Black Rock would be 36 feet deep at the dam and have a surface area of 15 acres. Reservoir clearing operations will be conducted within the maximum permanent pool level at the 4 sites.

Provision for control of water levels and for drawdown at each permanent pool are important to the management of the fish and wildlife resources. Stop-log type structures appear to be most desirable, and should control the entire elevation of the permanent pools at Hancock Brook and Hop Brook. Control of the upper 10-15 feet of the Black Rock pool, and provision for drawdown of the Black Rock and Northfield Brook permanent pools will be satisfactory. The permanent pools will be managed in a manner not inconsistent with authorized project purposes and the possibility exists that the pools may be drawn down at times for indefinite periods.

Provisions for the inclusion of permanent pools at each of these 4 reservoir sites with water control structures will adequately mitigate fish and wildlife losses resulting from project construction. In addition, it is felt that the measures discussed in the following paragraphs will create further fish and wildlife benefits at no more than incidental cost to the project.

The Hancock Brook site appears to have high potential value as a fish and wildlife management area. The State Board of Fisheries and Game desires that a General Plan for the conservation and development of fish and wildlife resources be executed for this reservoir area. They feel that the best present use of the Hancock Brook reservoir will be to develop it as a small game public hunting area under an intensive management plan. This plan will be geared primarily to developing the most effective pheasant management program, although benefits will accrue to other game species as well. Pheasant stocking, as a management feature, will be employed in a manner best suited to habitat conditions and hunter pressure. Modification of habitat, including that which provides wildlife food as well as cover, will be undertaken in order to adapt the area to best fit into this intensive type management plan. Under a wildlife

management plan, it is anticipated that the permanent pool will be held only periodically for management purposes such as control of vegetation, and so long as the downstream area of Hancock Brook maintains its value for trout.

Those portions of existing roads within the project sites and the railroad bed at the Hancock Brook site, will be valuable for future public access to the reservoir areas and permanent pools. While it is realized that some deterioration of these roads is inevitable during project construction, this deterioration should be minimized as much as possible.

A public access to the pool at the Hop Brook site appears feasible where Route 63 will enter the upper end of the pool. The point where Litchfield Street will enter the upper end of the permanent pool at the Northfield Brook site appears to be the most feasible location for a public access and boat launching point. It is understood that the Corps of Engineers will provide public access, including boat launching and vehicle parking facilities, at these 4 reservoir areas. Therefore, specific provisions for public access have not been made the subject of a recommendation.

Since all of the reservoir sites are small, construction activities and borrow operations will be more or less concentrated. Destruction of the existing vegetation along extensive portions of stream banks will increase damages to existing fisheries. Discharges of large quantities of mud and silt into the streams during construction will damage downstream fisheries values. It is realized that it is impossible to prevent silting of streams during construction operations, without involving additional costs. However, in order to minimize damages to fish and wildlife resources during construction it is recommended that representatives of this office and the State Board of Fisheries and Game be consulted at the time contract specifications are drawn up. It may be possible for fish and wildlife personnel to suggest at this time, means for reducing damages as a procedure in assuring that the reservcir area is left in as good a condition as possible for public use following construction.

The State Board of Fisheries and Game considers the expansion of lands for public hunting and fishing a key endeavor in its overall program. The State Board of Fisheries and Game desires to make an attempt to obtain hunting and fishing rights on lands upon which the construction agency will take flowage easements at the Hop Brook, Northfield Brook and Hancock Brook sites. The best means of accomplishing this appears to be through close coordination with the construction agency when that agency takes the flowage easements. This would mean that a State representative would negotiate for hunting and fishing rights at the same time as a representative of the construction agency is taking flowage easements.

Continuance of the existing commercial sand and gravel operations within the Hancock Brook reservoir site would be detrimental to fish and wildlife management of the reservoir area. Elimination of stream silting from this operation would improve the fishery potential of the stream, and the permanent pool.

RECOMMENDATIONS

We recommend:

1. That provisions be made for permanent pools at each site with approximately the following depths at the dam: Hancock Brook Dam, 6 feet; Northfield Brook Dam, 25 feet; Hop Brook Dam, 14 feet; and Black Rock Dam, 36 feet.

2. That permanent pool water control structures provide for the following: control of the entire pool elevation at Hancock Brook Dam and Hop Brook Dam; drawdown of the pool at the Northfield Brook Dam; and control of the upper 10-15 feet and drawdown at the Black Rock Dam.

3. That Federal lands and included water areas within the Hancock Brook project area, be made available to the Connecticut State Board of Fisheries and Game in accordance with a General Plan for wildlife management as provided in Sections 3 and 4 of the Fish and Wildlife Coordination Act, except for such portions as may be reserved by the construction agency for reasons of safety, efficient operation or protection of public property.

4. That insofar as possible the following roads and railroad bed within reservoir boundaries be preserved for public access purposes: Hancock Brook Dam, Todd Hollow Road, Waterbury Road and the bed of the New York-New Haven Railroad; Northfield Brook Dam, Litchfield Street; Hop Brook Dam, Routes 63, 188, and Bristol Street; and Black Rock Dam, Route 109 and Northfield Street.

5. That, insofar as possible, deposition of sediment in streams be minimized and existing streamside vegetation be maintained within 50 feet of stream banks at all sites except within permanent pool areas.

6. That representatives of the Connecticut State Board of Fisheries and Game and this office be consulted at the time contract specifications are drawn up to consider the most feasible means of minimizing damages to fish and wildlife habitat as a result of construction operations.

7. That the taking of flowage easements by the construction agency be coordinated with the anticipated taking of public fishing and hunting easements by the State at the Hop Brook, Northfield

Brook, and Hancock Brook Reservoir sites.

8. That no commercial sand and gravel operations be permitted within lands acquired by the Federal Government at Hancock Brook Reservoir.

9. That additional detailed studies of fish and wildlife resources affected by the project be conducted as necessary during further planning and construction phases of the project to form the basis for such reasonable modifications for the conservation and development of fish and wildlife resources as may be desirable to obtain maximum overall project benefits.

10. That additional modifications to achieve maximum project benefits to be made in project facilities or operations, subsequent to completion of construction, as may be desirable to obtain maximum overall project benefits, on the basis of follow-up studies by this Bureau to improve or supplement measures taken for the conservation and development of fish and wildlife resources, notwithstanding Paragraph (g) Section 2 of the Fish and Wildlife Coordination Act.

Sincerely yours,

John S. Gottschalk
Regional Director

Attachment

CORPS OF ENGINEERS

U.S. ARMY

MATCH LINE A-A

EAST BRANCH AND NAUGATUCK RIVER LOCAL PROTECTION (Completed)

WEST BRANCH LOCAL PROTECTION (Completed)

THOMASTON DAM AND RESERVOIR (Completed)

HALL MEADOW BROOK DAM (Under Construction)

EAST BRANCH DAM (Under Design)

NORTHFIELD BROOK DAM (Under Design)

BLACK ROCK DAM (Authorized)

WATERBURY & WATERTOWN LOCAL PROTECTION (Completed)

HANCOCK BROOK DAM

HOP BROOK DAM (Authorized)

ANSONIA-DERBY LOCAL PROTECTION (Recommended)

NORFOLK

WINCHESTER

GOSHEN

TORRINGTON

MATCH LINE TO A-A

LITCHFIELD

HARWINTON

EAST LITCHFIELD

MORRIS

THOMASTON

PLYMOUTH

WOLCOTT

WATERTOWN

OAKVILLE

WATERVILLE

WATERBURY

MIDDLEBURY

PLATTS MILL

UNION CITY

PROSPECT

NAUGATUCK

OXFORD

BEACON FALLS

BETHANY

SEYMOUR

ANSONIA

SHELTON

DERBY

HOUSATONIC RIVER

D.A.=189 S.M.

D.A.=71.9 S.M.

D.A.=240 S.M.

D.A.=100 S.M.

LOCATION MAP

SCALE IN MILES

NEW YORK

MASS.

CONN.

R.I.

NAUGATUCK RIVER BASIN

LONG ISLAND SOUND

LEGEND

COMPLETED

UNDER CONSTRUCTION

UNDER DESIGN OR AUTHORIZED

SCALE IN MILES

REVISIONS	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION
BOSTON, MASS.

DR. BY	TR. BY	CK. BY
S.F.C.	S.F.C.	J.W.D.

PROJECT ENGINEER

CHIEF PLANS & SPEC'S BRANCH

CHIEF ENGINEERING DIVISION

HOUSATONIC RIVER FLOOD CONTROL

NAUGATUCK RIVER WATERSHED BASIN MAP

NAUGATUCK RIVER, CONNECTICUT

DATE FEB. 1962

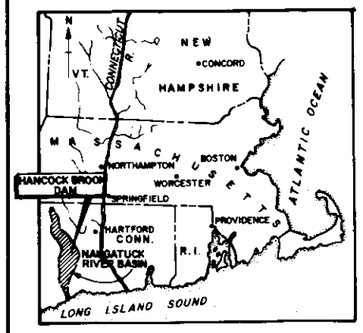
SCALE: AS SHOWN

DRAWING NUMBER

HC-1-1310

SHEET 1 OF 1

PLATE NO. 3-1



LOCATION MAP

SCALE IN MILES

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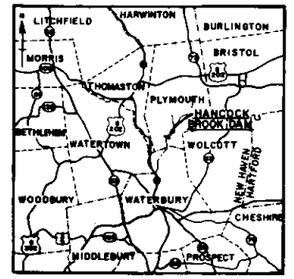
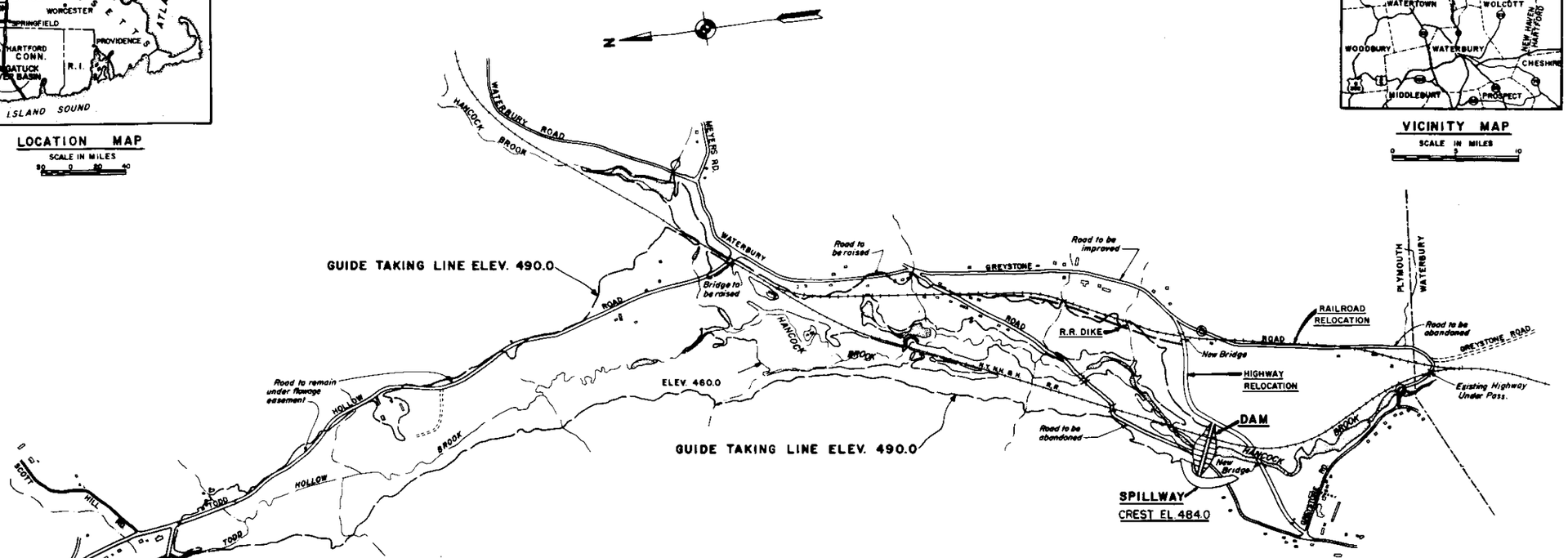


VICINITY MAP

SCALE IN MILES

0 5 10



RESERVOIR PLAN

SCALE IN FEET

500' 0 500' 1000'

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
M.W.B.	M.W.B.	

PROJECT ENGINEER

SUBMITTED BY

CHIEF, PLANS & SPEC'S BRANCH

CHIEF ENGINEERING DATE

HOUSATONIC RIVER FLOOD CONTROL

HANCOCK BROOK DAM
RESERVOIR MAP

HANCOCK BROOK CONNECTICUT

APPROVED DATE FEB. 1962

SCALE

SPEC. NO CIV ENG-19-016-

DRAWING NUMBER

SHEET

PLATE NO. 3-2

CORPS OF ENGINEERS

U. S. ARMY

NOTES:

Elevations refer to mean sea level

Contour interval = 10'

SCALE: 1" = 50'

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL

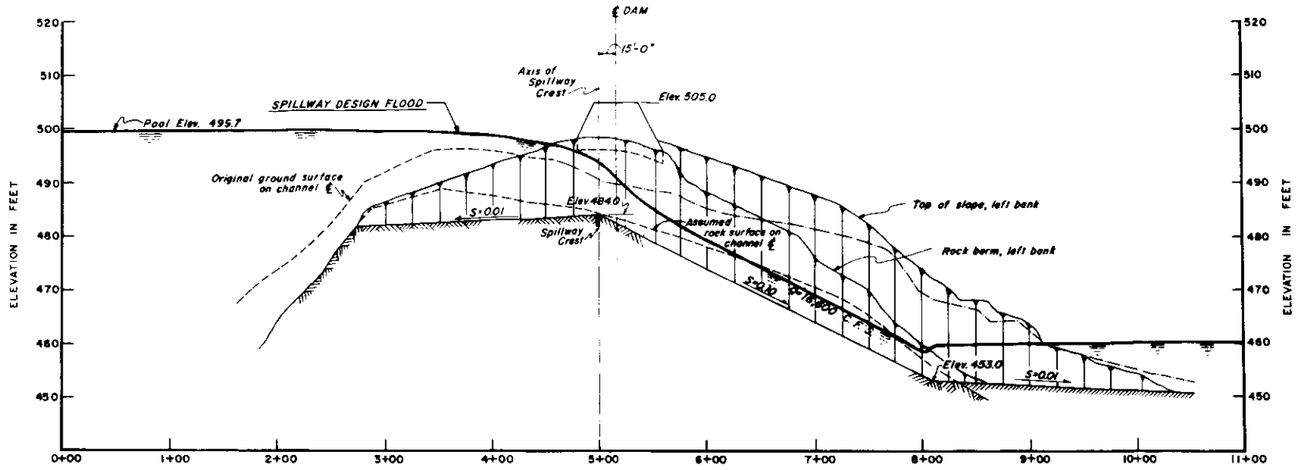
HANCOCK BROOK DAM
GENERAL PLAN

HANCOCK BROOK CONNECTICUT

DATE FEB. 1962

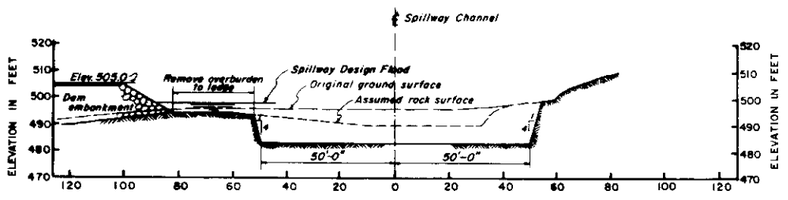
SPEC NO. ENG-19-016-

PLATE NO. 3-3



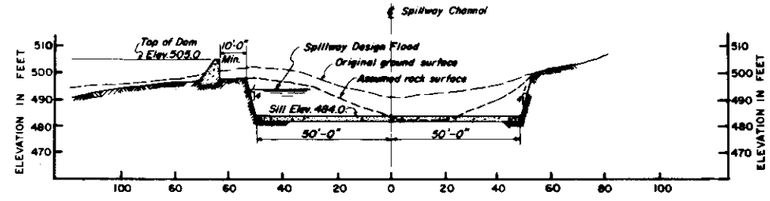
PROFILE ALONG ℄ OF SPILLWAY CHANNEL

SCALE: HOR. 1"=80'
VER. 1"=10'



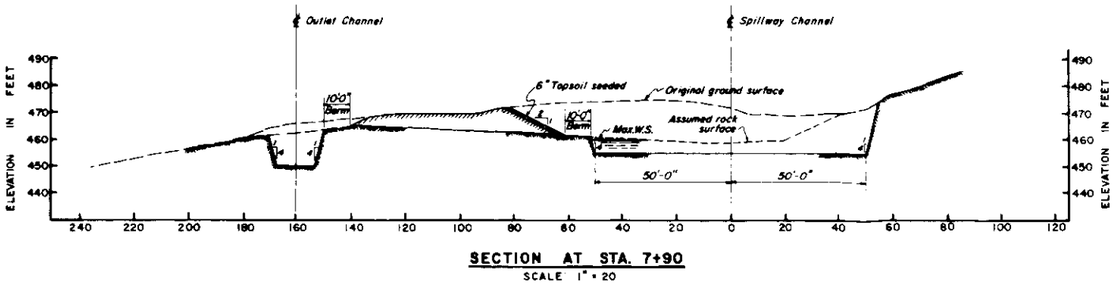
SECTION AT STA. 4+00

SCALE: 1" = 20"



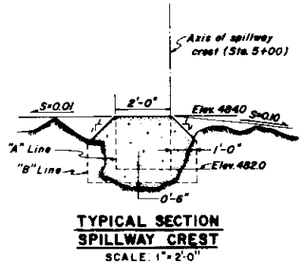
SECTION AT STA. 5+00

SCALE: 1" = 20'



SECTION AT STA. 7+90

SCALE: 1" = 20



TYPICAL SECTION
SPILLWAY CREST

SCALE: 1"=2'-0"

SCALE 1"=50'

SCALE 1"=20'

SCALE 1"=2'

NOTES:

Elevations refer to Mean Sea Level Datum

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY	TR. BY	CK. BY
H.B.F.	N.W.B.	

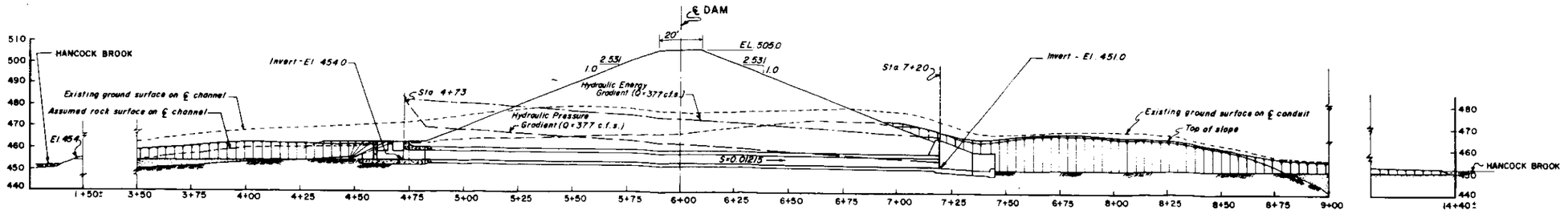
D.W. Hanke
PROJECT ENGINEER

CHIEF, SECTION
SUBMITTED BY
CHIEF, PLANS & SPEC'S & ESTIMATES BRANCH

HOUSATONIC RIVER FLOOD CONTROL
HANCOCK BROOK DAM
SPILLWAY PROFILE & SECTIONS
HANCOCK BROOK CONNECTICUT
APPROVED DATE FEB. 1962
CHIEF, ENGINEERING DIV.

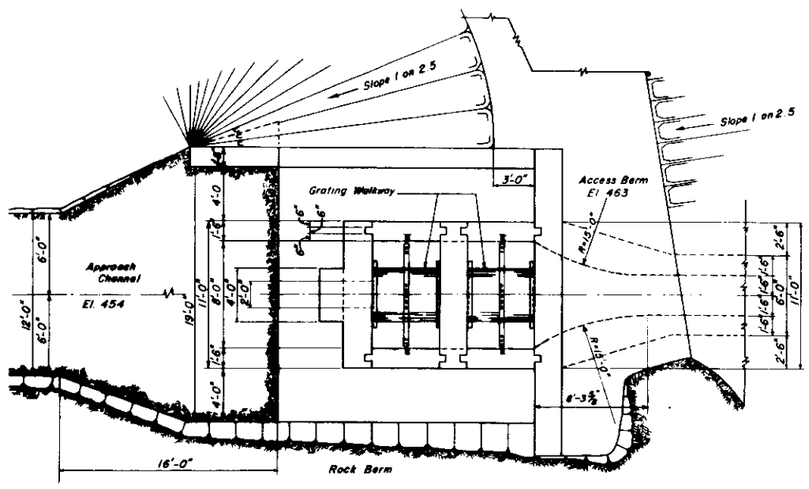
SCALE AS SHOWN | SPEC. NO. CIV ENG.-19-046-
DRAWING NUMBER
SHEET

PLATE NO. 3-14



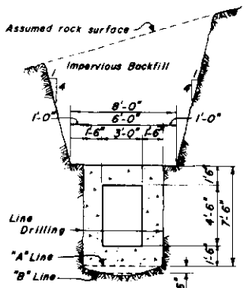
PROFILE ALONG ℄ OF OUTLET WORKS

SCALE: 1"= 20'



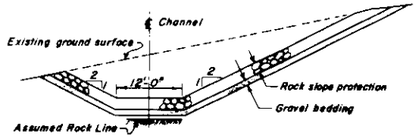
INTAKE STRUCTURE PLAN

SCALE: 1"= 4'-0"



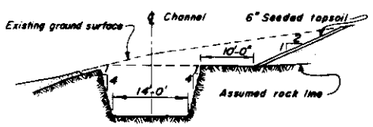
TYPICAL CONDUIT SECTION

SCALE: 1"= 4'-0"



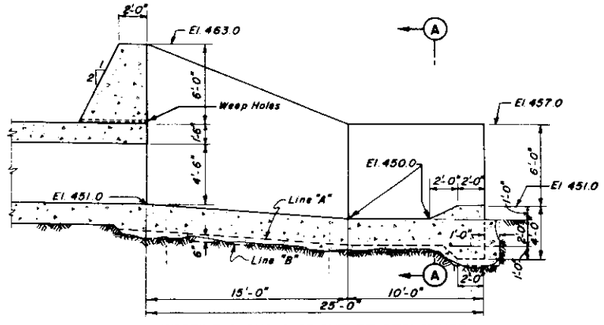
TYPICAL SECTION, INTAKE CHANNEL

SCALE: 1"= 10'



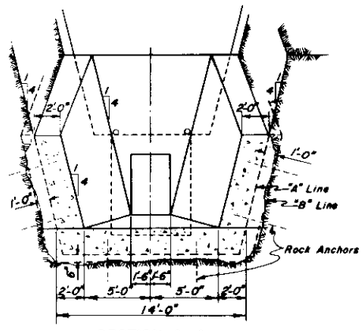
TYPICAL SECTION, OUTLET CHANNEL

SCALE: 1"= 10'



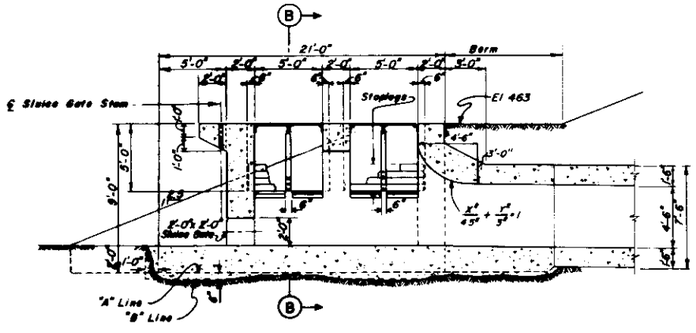
PROFILE ALONG ℄ OF OUTLET STRUCTURE

SCALE: 1"= 4'-0"



SECTION A-A

SCALE: 1"= 4'-0"



PROFILE ALONG ℄ INTAKE STRUCTURE

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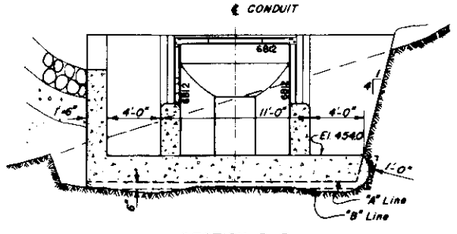

SECTION B-B

SCALE: 1"= 4'-0"

SCALE: 1"=20'

SCALE: 1"=10'

SCALE: 1"=4'

NOTES:
Elevations refer to Mean Sea Level Datum.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

DR. BY	TR. BY	CH. BY
E.B.M.	G.H.O.	J.H.D.

HOUSATONIC RIVER FLOOD CONTROL

HANCOCK BROOK DAM

OUTLET WORKS DETAILS

PROJECT ENGINEER

CHIEF, SECTION

HANCOCK BROOK CONNECTICUT

SUBMITTED BY

APPROVED

DATE FEB 1962

CHIEF, PLANS & SPEC'S BRANCH

CHIEF ENGINEERING DIV.

SCALE AS SHOWN | SPEC. NO CIV ENG-8-018-

DRAWING NUMBER

SHEET

PLATE NO. 3-5